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WEIGHTS OF VARIOUS WOODS GROWN IN THE UNITED STATES

The exact weight of either sawed or round timbers is best determined by weighing. Calculated values of weights, such as discussed here, are necessarily approximate values owing to variations in moisture content, density, sapwood thickness, and the like that occur in different parts of the same timber. The calculated average weight obtained by the method given here is, therefore, not accurate enough to afford a basis for estimating timber transportation costs or other exacting transactions. On the other hand, the method is useful in making rough estimates of timber weights for less exacting purposes, for example, truck capacity needed to haul a given lot of timbers, storing logs under water, or determining the possibility of driving or towing logs.

There is enough difference between the weights of sawed and round timbers to require separate methods for estimating their average weights. Part I of this note is applicable to sawed timbers; Part II is applicable to round timbers.

PART I. SAWED TIMBERS

Table 1 gives for various woods grown in the United States the average weights per cubic foot of sawed timbers at moisture content values of 8 and 15 percent, and the average weight of 1,000 board feet when air dry (15 percent moisture content). Factors for adjusting values for each 1 percent change in moisture content are given.

Table 1 is based on the weights and volumes of 2-by 2-inch, clear specimens from the top 4 feet of 16-foot butt logs of typical trees.

In any lot of lumber of a given species in the air-dry condition at 15 percent moisture content, the weight per cubic foot will rarely vary more than 10 percent from the figure given in table 1. The greatest changes in weight are those that occur in the early stages of drying of green wood. Changes in the moisture content of air-dry wood are attended by only relatively small changes in weight per cubic foot, owing to the counter effect of change in volume as a result of accompanying shrinkage and swelling.

The values given in table 1 for weight per thousand board feet at 15 percent moisture content were determined by multiplying the values per cubic foot at 15 percent by 83.3. The weights per thousand feet given in column 5 apply to actual board feet and not to a thousand board feet lumber scale. Rough lumber is generally oversized and dressed lumber undersized with respect to thickness. The values given in column 5 of table 1 will generally, therefore, need to be adjusted for actual shipments of lumber. The adjustment for 1- by 8-inch boards dressed to 25/32 inch in thickness and 7-1/2 inches in width is as follows:

$$\frac{25/32 \times 7\text{-}1/2}{1 \times 8} = 0.7324.$$

Table 1.--Weights of sawed wood of various trees grown in the United States, under different conditions of moisture, and accompanying adjusting factors

Species (common and botanical names)	Weight in pounds per cubic foot: Based on weight and volume at a moisture content of 15 percent	Weight in pounds per cubic foot: Based on weight and volume at a moisture content of 8 percent	Factors[1] for adjusting values for each 1 percent change in moisture content:	Weight per 1,000 board feet air dry (15 percent moisture content): Actual board feet	Weight per 1,000 board feet air dry (15 percent moisture content): Dressed (1 x 8 dressed to 25/32 x 7-1/2)
(1)	(2)	(3)	(4)	(5)	(6)
Alder red (Alnus rubra)	28.2	27.7	0.075	2,350	1,720
Apple, wild (Malus pumila) var.	47.2	46.8	.050	3,930	2,880
Ash, black (Fraxinus nigra)	34.5	33.9	.092	2,870	2,100
Ash, commercial white[2] (Fraxinus sp.)	40.6	39.6	.137	3,380	2,480
Aspen, commercial[2] (Populus sp.)	26.6	26.0	.087	2,220	1,630
Baldcypress (Taxodium distichum)	32.0	31.1	.129	2,670	1,960
Basswood, American (Tilia americana)	25.3	25.1	.029	2,110	1,550
Beech, American (Fagus grandifolia)	43.3	42.6	.095	3,610	2,640
Birch, Alaska paper (Betula papyrifera var. neoalaskana)	37.9	37.5	.054	3,160	2,310
Birch, paper (Betula papyrifera)	37.9	37.7	.029	3,160	2,310
Birch, sweet (Betula lenta)	46.2	45.4	.108	3,850	2,820
Birch, yellow (Betula lutea)	42.4	41.9	.071	3,530	2,590
Buckeye, yellow (Aesculus octandra)	24.9	24.4	.067	2,070	1,520
Butternut (Juglans cinerea)	27.0	26.2	.117	2,250	1,650
California-laurel (Umbellularia californica)	38.8	37.8	.137	3,230	2,370
Cherry, black (Prunus serotina)	35.5	34.5	.145	2,960	2,170
Chestnut, American (Castanea dentata)	30.0	29.2	.108	2,500	1,830
Chinquapin, golden (Castanopsis chrysophylla)	31.7	31.0	.104	2,640	1,930
Cottonwood, black (Populus trichocarpa)	24.0	23.5	.071	2,000	1,460
Cottonwood, eastern (Populus deltoides)	28.3	27.7	.087	2,360	1,730
Cucumbertree (Magnolia acuminata)	33.6	32.9	.095	2,800	2,050
Dogwood, flowering (Cornus florida)	50.0	49.8	.025	4,160	3,050
Dogwood, Pacific (Cornus nuttallii)	44.8	44.3	.071	3,730	2,730
Douglas-fir (Pseudotsuga taxifolia) coast type	33.9	33.0	.129	2,820	2,070
Douglas-fir (Pseudotsuga taxifolia glauca) Inland Empire type	31.2	30.5	.100	2,600	1,900
Douglas-fir (Pseudotsuga taxifolia glauca) mountain type	30.1	29.0	.154	2,510	1,840
Elm, rock (Ulmus thomasi)	43.4	42.3	.158	3,620	2,650
Elm, soft[4] (Ulmus sp.)	36.3	35.7	.083	3,020	2,210
Fir, alpine (Abies lasiocarpa)	22.3	21.2	.154	1,860	1,360
Fir, balsam (Abies balsamea)	26.1	26.0	.021	2,170	1,590
Fir, noble (Abies procera)	26.6	25.9	.095	2,220	1,630
Fir, California red (Abies magnifica)	27.9	27.0	.129	2,320	1,700
Fir, commercial white[2] (Abies sp.)	27.0	26.3	.095	2,250	1,650
Hackberry (Celtis occidentalis)	36.8	35.9	.133	3,070	2,250
Hemlock, eastern (Tsuga canadensis)	28.5	27.7	.117	2,370	1,740

Table 1.--Weights of sawed wood of various trees grown in the United States, under different conditions of moisture, and accompanying adjusting factors (continued)

Species (common and botanical names)	Weight in pounds per cubic foot: Based on weight and volume at a moisture content of 15 percent	Based on weight and volume at a moisture content of 8 percent	Factors[1] for adjusting values for each 1 percent change in moisture content	Weight per 1,000 board feet air dry (15 percent moisture content): Actual board feet	Dressed (1 x 8 dressed to 25/32 x 7-1/2)
(1)	(2)	(3)	(4)	(5)	(6)
Hemlock, western (Tsuga heterophylla)	29.1	28.4	0.095	2,420	1,770
Hickories, true[6] (Carya sp.)	50.3	50.2	.021	4,190	3,070
Hickory, water (Carya aquatica)	44.2	42.0	.308	3,680	2,700
Holly, American (Ilex opaca)	38.9	38.4	.071	3,240	2,370
Honeylocust (Gleditsia triacanthos)	44.7	43.2	.208	3,720	2,720
Hophornbeam, eastern (Ostrya virginiana)	48.9	48.3	.087	4,070	2,980
Incense-cedar, California (Libocedrus decurrens)	25.3	24.1	.170	2,110	1,550
Juniper, alligator (Juniperus pachyphloea)	36.1	35.1	.137	3,010	2,200
Larch, western (Larix occidentalis)	38.3	37.7	.092	3,190	2,340
Locust, black (Robinia pseudacacia)	48.6	46.5	.295	4,050	2,970
Madrone, Pacific (Arbutus menziesii)	44.5	43.9	.079	3,710	2,720
Magnolia, southern (Magnolia grandiflora)	34.9	34.1	.120	2,910	2,130
Mangrove (Rhizophora mangle)	68.3	67.4	.133	5,690	4,170
Maple, bigleaf (Acer macrophyllum)	33.5	32.8	.100	2,790	2,040
Maple, hard[7] (Acer sp.)	41.7	41.1	.087	3,470	2,540
Maple, soft[8] (Acer sp.)	34.9	33.9	.137	2,910	2,130
Mountain-laurel (Kalmia latifolia)	47.7	47.1	.083	3,970	2,910
Oak, red[2] (Quercus sp.)	43.4	42.8	.079	3,620	2,650
Oak, white[10] (Quercus sp.)	45.9	45.4	.071	3,820	2,800
Osage-orange (Maclura pomifera)	56.7	54.7	.291	4,720	3,460
Palmetto, cabbage (Sabal palmetto)	28.9	28.6	.042	2,410	1,770
Pecan (Carya Illinoensis)	45.6	44.5	.154	3,800	2,780
Persimmon (Diospyros virginiana)	49.5	49.0	.075	4,120	3,020
Pine, eastern white (Pinus strobus)	25.1	24.0	.150	2,090	1,530
Pine, jack (Pinus banksiana)	29.9	29.0	.129	2,490	1,820
Pine, lodgepole (Pinus contorta latifolia)	28.7	27.9	.108	2,390	1,750
Pine, pitch (Pinus rigida)	34.3	33.5	.108	2,860	2,090
Pine, ponderosa (Pinus ponderosa)	28.3	27.3	.142	2,360	1,730
Pine, red (Pinus resinosa)	30.9	30.2	.104	2,570	1,880
Pine, slash (Pinus caribaea)	43.1	42.3	.120	3,590	2,630
Pine, southern yellow:					
Loblolly (Pinus taeda)	35.6	34.8	.108	2,970	2,180
Longleaf (Pinus palustris)	40.8	39.9	.129	3,990	2,920
Shortleaf (Pinus echinata)	35.0	34.2	.108	2,920	2,140
Pine, sugar (Pinus lambertiana)	25.8	24.8	.145	2,150	1,570
Pine, western white (Pinus monticola)	27.5	26.8	.095	2,290	1,680
Poplar, balsam (Populus tacamahaca)	22.7	22.2	.071	1,890	1,380
Redcedar, eastern (Juniperus virginiana)	33.1	32.0	.158	2,760	2,020

Table 1.--Weights of sawed wood of various trees grown in the United States, under different conditions of moisture, and accompanying adjusting factors (continued)

Species (common and botanical names)	Weight in pounds per cubic foot: Based on weight and volume at a moisture content of 15 percent	Weight in pounds per cubic foot: Based on weight and volume at a moisture content of 8 percent	Factors[1] for adjusting values for each 1 percent change in moisture content	Weight per 1,000 board feet air dry (15 percent moisture content): Actual board feet	Weight per 1,000 board feet air dry (15 percent moisture content): Dressed (1 x 8 dressed to 25/32 x 7-1/2)
(1)	(2)	(3)	(4)	(5)	(6)
Redcedar, western (Thuja plicata)	23.1	22.3	0.117	1,920	1,410
Redwood[11] (Sequoia sempervirens)	25.4	24.5	.129	2,120	1,550
Spruce, eastern[12] (Picea sp.)	28.4	27.6	.108	2,370	1,740
Spruce, Engelmann (Picea engelmanni)	23.7	23.0	.104	1,970	1,440
Spruce, Sitka (Picea sitchensis)	27.8	27.0	.120	2,320	1,700
Sugarberry (Celtis laevigata)	35.9	35.0	.125	2,990	2,190
Sweetgum (Liquidambar styraciflua)	34.1	33.6	.067	2,840	2,080
Sycamore, American (Platanus occidentalis)	34.9	34.3	.087	2,910	2,130
Tamarack (Larix laricina)	37.1	36.0	.150	3,090	2,260
Tupelo[13] (Nyssa sp.)	35.0	34.3	.095	2,920	2,140
Walnut, black (Juglans nigra)	38.1	36.7	.204	3,170	2,320
White-cedar, Atlantic (Chamaecyparis thyoides)	23.4	22.7	.095	1,950	1,430
White-cedar, northern (Thuja occidentalis)	21.6	20.7	.129	1,800	1,320
White-cedar, Port Orford (Chamaecyparis lawsoniana)	29.8	28.7	.154	2,480	1,820
Willow, black (Salix nigra)	26.1	25.8	.046	2,170	1,590
Yellow-cedar, Alaska (Chamaecyparis nootkatensis)	31.1	30.1	.142	2,590	1,900
Yellow-poplar (Liriodendron tulipifera)	28.3	27.5	.112	2,360	1,730
Yew, Pacific (Taxus brevifolia)	45.1	43.7	.204	3,760	2,750

[1] To adjust value to any desired moisture content between 0 and 30 percent, add factor to be adjusted for each 1 percent increase in moisture content; subtract factor from value to be adjusted for each 1 percent decrease in moisture content. These factors take shrinkage or swelling with moisture changes into consideration. For weight values above 30 percent moisture content, use table 4.

[2] Includes blue ash, green ash, and white ash.

[3] Includes bigtooth aspen and quaking aspen.

[4] Includes American elm and slippery elm.

[5] Includes grand fir, Pacific silver fir, and white fir.

[6] Includes mockernut hickory, pignut hickory, shagbark hickory, and shellbark hickory.

[7] Includes black maple and sugar maple.

[8] Includes red maple and silver maple.

[9] Includes black oak, laurel oak, northern red oak, southern red oak, swamp red oak, water oak, and willow oak.

[10] Includes bur oak, post oak, swamp chestnut oak, and white oak.

[11] Includes virgin redwood and second-growth redwood.

[12] Includes black spruce, red spruce, and white spruce.

[13] Includes black tupelo and water tupelo.

The value given in column 5 of table 1 (actual board feet 15 percent m.c.) multiplied by this adjustment factor, gives the weight of the dressed lumber. The adjustment for rough oversized lumber is made in similar fashion, that is, actual size divided by nominal size. In like manner constants for any dressed size may be worked out and the weight per 1,000 board feet computed.

Column (6) is an example of the weight per 1,000 board feet of 1-by 8-inch boards dressed to 25/32 inch in thickness and 7-1/2 inches in width for various species. It has been computed by multiplying the values in column 5 by the foregoing constant 0.7324.

PART II. ROUND TIMBERS

The weight per unit volume of green round timbers, such as logs, pulpwood, posts, poles, and piling, may be estimated by means of tables 2, 3, and 4. Table 2 gives the average specific gravity and moisture content of sapwood and heartwood of round timbers of various species in the green condition. Table 3 gives the percentage of sapwood in round timbers for various thicknesses, and diameters. Table 4 gives the weight per cubic foot of green wood at various specific gravities and moisture content values.

All three tables are necessary for estimating the weight per cubic foot of round timbers because in round timbers the proportions of sapwood and heartwood in the total volume often differ widely. Furthermore, the sapwood generally contains more water than the heartwood and both the sapwood and heartwood contain more moisture in the butt logs than in the top logs.

The following example illustrates how to determine the approximate weight per cubic foot of green round timber using tables 2, 3, and 4:

Example:

Given a species, say, black tupelo. The average specific gravity for the species is found from table 2 to be 0.46. The moisture content of the sapwood can be determined by actual measurement or estimated from table 2 as 115 percent. The moisture content of the heartwood can be determined by actual measurement or estimated from table 2 as 87 percent.

Next measure the average diameter of the timber and average width of sapwood. If the average diameter is, say, 10 inches and average sapwood thickness is 1-3/4 inches, then from table 3 the percentage of the volume of the round timber occupied by the sapwood is found to be 58 percent. The percentage of the volume occupied by the heartwood will therefore be, 100 percent minus 58 percent, or 42 percent.

Turning to table 4, and looking under a specific gravity of 0.46 for a sapwood moisture content of 115 percent, the weight per cubic foot is found to be 61.7 pounds per cubic foot. Under the same specific gravity value and a moisture content of 87 percent the weight of the heartwood is estimated to be half way between that given for moisture content values of 86 percent and 88 percent, or 53.7 pounds per cubic foot. (Moisture content values in the left column may be applied to either sapwood or heartwood.)

Table 2.--Average moisture content and specific gravity of green timbers

Species	Moisture content		Average specific gravity[1]
	Heartwood	Sapwood	
	Percent	Percent	
Softwoods:			
Baldcypress	121	171	0.42
Cedar, western red	58	249	.31
Douglas-fir (coast)	37	115	.45
Fir, grand	91	136	.37
Fir, white	98	160	.35
Hemlock, eastern	97	119	.38
Hemlock, western	85	170	.38
Larch, western	54	119	.50
Pine, loblolly	33	110	.47
Pine, lodgepole	41	120	.38
Pine, longleaf	31	106	.54
Pine, ponderosa	40	148	.38
Pine, eastern white	.....	.....	.34
Pine, western white	62	148	.36
Pine, red	32	134	.41
Pine, shortleaf	32	122	.46
Pine, sugar	98	219	.35
Redwood (virgin)	86	210	.38
Spruce, Engelmann	51	173	.32
Spruce, Sitka	41	142	.37
Hardwoods			
Ash, green	.....	58	.53
Ash, white	46	44	.55
Beech, American	55	72	.56
Birch, sweet	75	70	.60
Birch, yellow	74	72	.55
Chestnut, American	120	.....	.40
Elm, American	95	92	.46
Elm, cedar	66	61	.60
Hickory, water	97	62	.61
Maple, silver	58	97	.44
Maple, sugar	65	72	.56
Oak, black	76	75	.56
Oak, northern red	80	69	.56
Oak, southern red	83	75	.52
Oak, swamp red	79	66	.61
Oak, water	81	81	.56
Oak, white	64	78	.60
Oak, willow	82	74	.56
Tupelo, black	87	115	.46
Tupelo, water	158	.....	.46
Sweetgum	79	137	.44
Sycamore, American	114	130	.46
Yellow-poplar	83	106	.38

[1] Based on weight when oven dry and volume when green.

To find the weight in pounds per cubic foot of the round timber it is necessary to multiply the weight of sapwood by the percentage of sapwood divided by 100. Similarly for heartwood. Their sum gives the weight of the round timber in pounds per cubic foot.

Thus: 61.7 x 58/100 = 35.8 pounds

53.7 x 42/100 = 22.6 pounds

Total weight of round timber per cubic foot = 35.8 + 22.6 = 58.4 pounds.

Table 3.--Sapwood, in percent of volume, of round timbers

Sapwood thickness:	Average diameter of timber in inches												
	4	5	6	7	8	9	10	11	12	13	14	15	16
Inches													
1/4	23	19	16	14	12	11	10	9	8	8	7	7	6
1/2	44	36	31	27	23	21	19	17	16	15	14	13	12
3/4	61	51	44	38	34	31	28	25	23	22	20	19	18
1	75	64	56	49	44	40	36	33	31	28	27	25	23
1-1/4	86	75	66	59	53	48	44	40	37	35	33	31	29
1-1/2	94	84	75	67	61	56	51	47	44	41	38	36	34
1-3/4	98	91	83	75	68	63	58	54	50	47	44	41	39
2	100	96	89	82	75	69	64	60	56	52	49	46	44
2-1/4	...	99	94	87	81	75	70	65	61	57	54	51	48
2-1/2	...	100	97	92	86	80	75	70	66	62	59	56	53
2-3/4	...	...	99	96	90	85	80	75	71	67	63	60	57
3	...	...	100	98	94	89	84	79	75	71	67	64	61
3-1/4	...	...	...	99	96	92	88	83	79	75	71	68	65
3-1/2	...	...	...	100	98	95	91	87	83	79	75	72	69
3-3/4	...	...	...	...	100	97	94	90	86	82	78	75	72
4	...	...	...	...	100	99	96	93	89	85	82	78	75
4-1/4	...	...	...	...	...	100	98	95	91	88	85	81	78
4-1/2	...	...	...	...	...	100	99	97	94	91	87	84	81
4-3/4	...	...	...	...	...	...	100	99	96	93	90	87	83
5	...	...	...	...	...	...	100	99	97	95	93	90	86

Table 4.--Weight in pounds per cubic foot of green wood at various specific gravities and moisture contents

Moisture content	Specific gravity, based on oven-dry weight and green volume																				
	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70
Percent																					
30	24.3	26.0	27.6	29.2	30.8	32.4	34.1	35.7	37.3	38.9	40.6	42.2	43.8	45.4	47.0	48.7	50.3	51.9	53.5	55.2	56.8
32	24.7	26.4	28.0	29.7	31.3	32.9	34.6	36.2	37.9	39.5	41.2	42.8	44.5	46.1	47.8	49.4	51.1	52.7	54.4	56.0	57.7
34	25.1	26.8	28.4	30.1	31.8	33.4	35.1	36.8	38.5	40.1	41.8	43.5	45.2	46.8	48.5	50.2	51.8	53.5	55.2	56.9	58.5
36	25.5	27.2	28.9	30.6	32.2	33.9	35.6	37.3	39.0	40.7	42.4	44.1	45.8	47.5	49.2	50.9	52.6	54.3	56.0	57.7	59.4
38	25.8	27.6	29.3	31.0	32.7	34.4	36.2	37.9	39.6	41.3	43.1	44.8	46.5	48.2	49.9	51.7	53.4	55.1	56.8	58.6	60.3
40	26.2	28.0	29.7	31.4	33.2	34.9	36.7	38.4	40.2	41.9	43.7	45.4	47.2	48.9	50.7	52.4	54.2	55.9	57.7	59.4	61.2
42	26.6	28.4	30.1	31.9	33.7	35.4	37.2	39.0	40.8	42.5	44.3	46.1	47.8	49.6	51.4	53.2	54.9	56.7	58.5	60.3	62.0
44	27.0	28.8	30.6	32.3	34.1	35.9	37.7	39.5	41.3	43.1	44.9	46.7	48.5	50.3	52.1	53.9	55.7	57.5	59.3	61.1	62.9
46	27.3	29.2	31.0	32.8	34.6	36.4	38.3	40.1	41.9	43.7	45.6	47.4	49.2	51.0	52.8	54.7	56.5	58.3	60.1	62.0	63.8
48	27.7	29.6	31.4	33.2	35.1	36.9	38.8	40.6	42.5	44.3	46.2	48.0	49.9	51.7	53.6	55.4	57.3	59.1	61.0	62.8	64.6
50	28.1	30.0	31.8	33.7	35.6	37.4	39.3	41.2	43.1	44.9	46.8	48.7	50.5	52.4	54.3	56.2	58.0	59.9	61.8	63.6	65.5
52	28.5	30.4	32.2	34.1	36.0	37.9	39.8	41.7	43.6	45.5	47.4	49.3	51.2	53.1	55.0	56.9	58.8	60.7	62.6	64.5	66.4
54	28.8	30.8	32.7	34.6	36.5	38.4	40.4	42.3	44.2	46.1	48.0	50.0	51.9	53.8	55.7	57.7	59.6	61.5	63.4	65.3	67.3
56	29.2	31.2	33.1	35.0	37.0	38.9	40.9	42.8	44.8	46.7	48.7	50.6	52.6	54.5	56.5	58.4	60.4	62.3	64.2	66.2	68.1
58	29.6	31.5	33.5	35.5	37.5	39.4	41.4	43.4	45.4	47.3	49.3	51.3	53.2	55.2	57.2	59.2	61.1	63.1	65.1	67.0	69.0
60	30.0	31.9	33.9	35.9	37.9	39.9	41.9	43.9	45.9	47.9	49.9	51.9	53.9	55.9	57.9	59.9	61.9	63.9	65.9	67.9	69.9
62	30.3	32.3	34.4	36.4	38.4	40.4	42.5	44.5	46.5	48.5	50.5	52.6	54.6	56.6	58.6	60.7	62.7	64.7	66.7	68.7	70.8
64	30.7	32.7	34.8	36.8	38.9	40.9	43.0	45.0	47.1	49.1	51.2	53.2	55.3	57.3	59.4	61.4	63.4	65.5	67.5	69.6	71.6
66	31.1	33.1	35.2	37.3	39.4	41.4	43.5	45.6	47.6	49.7	51.8	53.9	55.9	58.0	60.1	62.2	64.2	66.3	68.4	70.4	72.5
68	31.4	33.5	35.6	37.7	39.8	41.9	44.0	46.1	48.2	50.3	52.4	54.5	56.6	58.7	60.8	62.9	65.0	67.1	69.2	71.3	73.4
70	31.8	33.9	36.1	38.2	40.3	42.4	44.6	46.7	48.8	50.9	53.0	55.2	57.3	59.4	61.5	63.6	65.8	67.9	70.0	72.1	74.3
72	32.2	34.3	36.5	38.6	40.8	42.9	45.1	47.2	49.4	51.5	53.7	55.8	58.0	60.1	62.3	64.4	66.5	68.7	70.8	73.0	75.1
74	32.6	34.7	36.9	39.1	41.3	43.4	45.6	47.8	49.9	52.1	54.3	56.5	58.6	60.8	63.0	65.1	67.3	69.5	71.7	73.8	76.0
76	32.9	35.1	37.3	39.5	41.7	43.9	46.1	48.3	50.5	52.7	54.9	57.1	59.3	61.5	63.7	65.9	68.1	70.3	72.5	74.7	76.9
78	33.3	35.5	37.8	40.0	42.2	44.4	46.7	48.9	51.1	53.3	55.5	57.8	60.0	62.2	64.4	66.6	68.9	71.1	73.3	75.5	77.8
80	33.7	35.9	38.2	40.4	42.7	44.9	47.2	49.4	51.7	53.9	56.2	58.4	60.7	62.9	65.1	67.4	69.6	71.9	74.1	76.4	78.6
82	34.1	36.3	38.6	40.9	43.2	45.4	47.7	50.0	52.2	54.5	56.8	59.1	61.3	63.6	65.9	68.1	70.4	72.7	75.0	77.2	79.5
84	34.4	36.7	39.0	41.3	43.6	45.9	48.2	50.5	52.8	55.1	57.4	59.7	62.0	64.3	66.6	68.9	71.2	73.5	75.8	78.1	80.4
86	34.8	37.1	39.5	41.8	44.1	46.4	48.7	51.1	53.4	55.7	58.0	60.4	62.7	65.0	67.3	69.6	72.0	74.3	76.6	78.9	81.2
88	35.2	37.5	39.9	42.2	44.6	46.9	49.3	51.6	54.0	56.3	58.7	61.0	63.3	65.7	68.0	70.4	72.7	75.1	77.4	79.8	82.1
90	35.6	37.9	40.3	42.7	45.1	47.4	49.8	52.2	54.5	56.9	59.3	61.7	64.0	66.4	68.8	71.1	73.5	75.9	78.2	80.6	83.0
92	35.9	38.3	40.7	43.1	45.5	47.9	50.3	52.7	55.1	57.5	59.9	62.3	64.7	67.1	69.5	71.9	74.3	76.7	79.1	81.5	83.9
94	36.3	38.7	41.2	43.6	46.0	48.4	50.8	53.3	55.7	58.1	60.5	62.9	65.4	67.8	70.2	72.6	75.1	77.5	79.9	82.3	84.7
96	36.7	39.1	41.6	44.0	46.5	48.9	51.4	53.8	56.3	58.7	61.2	63.6	66.0	68.5	70.9	73.4	75.8	78.3	80.7	83.2	85.6
98	37.1	39.5	42.0	44.5	46.9	49.4	51.9	54.4	56.8	59.3	61.8	64.2	66.7	69.2	71.7	74.1	76.6	79.1	81.5	84.0	86.5
100	37.4	39.9	42.4	44.9	47.4	49.9	52.4	54.9	57.4	59.9	62.4	64.9	67.4	69.9	72.4	74.9	77.4	79.9	82.4	84.9	87.4
105	38.4	40.9	43.5	46.1	48.6	51.2	53.7	56.3	58.8	61.4	64.0	66.5	69.1	71.6	74.2	76.8	79.3	81.9	84.4	87.0	89.5
110	39.3	41.9	44.6	47.2	49.8	52.4	55.0	57.7	60.3	62.9	65.5	68.1	70.8	73.4	76.0	78.6	81.2	83.9	86.5	89.1	91.7
115	40.2	42.9	45.6	48.3	51.0	53.7	56.3	59.0	61.7	64.4	67.1	69.8	72.4	75.1	77.8	80.5	83.2	85.9	88.5	91.2	93.9
120	41.2	43.9	46.7	49.4	52.2	54.9	57.7	60.4	63.1	65.9	68.6	71.4	74.1	76.9	79.6	82.4	85.1	87.9	90.6	93.4	96.1
125	42.1	44.9	47.7	50.5	53.4	56.2	59.0	61.8	64.6	67.4	70.2	73.0	75.8	78.6	81.4	84.2	87.0	89.9	92.7	95.5	98.3
130	43.1	45.9	48.8	51.7	54.5	57.4	60.3	63.1	66.0	68.9	71.8	74.6	77.5	80.4	83.2	86.1	89.0	91.9	94.7	97.6	100.5
135	44.0	46.9	49.9	52.8	55.7	58.7	61.6	64.5	67.5	70.4	73.3	76.3	79.2	82.1	85.1	88.0	90.9	93.8	96.8	99.7	102.6
140	44.9	47.9	50.9	53.9	56.9	59.9	62.9	65.9	68.9	71.9	74.9	77.9	80.9	83.9	86.9	89.9	92.9	95.8	98.8	101.8	104.8
145	45.9	48.9	52.0	55.0	58.1	61.2	64.2	67.3	70.3	73.4	76.4	79.5	82.6	85.6	88.7	91.7	94.8	97.8	100.9	104.0	107.0
150	46.8	49.9	53.0	56.2	59.3	62.4	65.5	68.6	71.8	74.9	78.0	81.1	84.2	87.4	90.5	93.6	96.7	99.8	103.0	106.1	109.2

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